

# Development of a Selenium Standard for the Open Waters of Great Salt Lake

## Great Salt Lake Water Quality Studies

### Understanding Toxicity Curves

#### How do we measure the effect of selenium on egg hatchability?

- This has been a subject of discussion in the scientific community for some time.
- The Science Panel concluded that the best available information for predicting effects of selenium on egg hatchability is from six laboratory studies that included different levels of selenium in the diet of mallards to determine the toxicity, or harmful effect, of selenium on egg hatchability.
- The Science Panel concluded that the best statistical analysis that describes the results of these mallard studies was developed by Harry Ohlendorf in 2003.

TABLE 1. Egg Selenium Concentration vs. Best Estimate of Reduction in Mallard Egg Hatchability

Egg Selenium Concentration (mg Se/kg dw)	Best Estimate of Reduction in Mallard Egg Hatchability		
	Most Likely	Best Case (2.5% chance of occurring)	Worst Case (2.5% chance of occurring)
6.4	2%	<1%	10%
8.2	3%	<1%	15%
12	10%	4%	26%
14	14%	5%	31%
16	21%	10%	38%

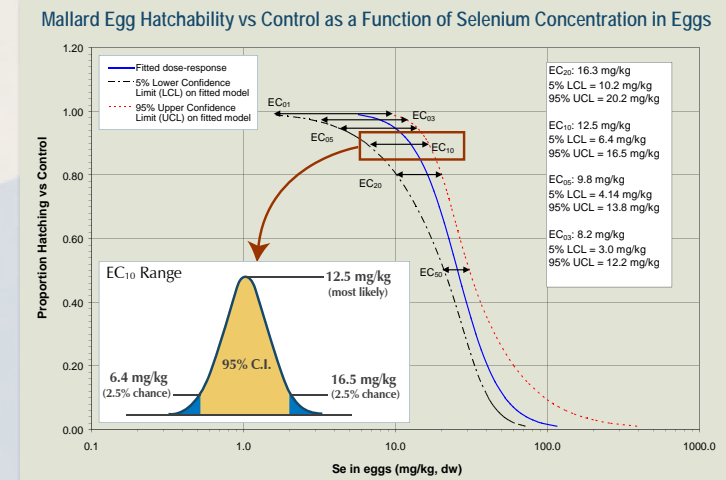
Note: The range of egg selenium concentrations identified for consideration by the Science Panel in November 2006 is 6.4 to 16 mg Se/kg dw. See also Ohlendorf 2003 and Fact Sheet: Recommended Guidelines for a Water Quality Standard for Selenium in Great Salt Lake.

TABLE 2. Reduction in Mallard Egg Hatchability vs Best Estimate of Egg Selenium Concentration

Reduction in Mallard Egg Hatchability	Best Estimate of Egg Selenium Concentration (mg Se/kg dw)		
	Most Likely	95% Confident Value is Within This Range	
1%	5.7	1.6	9.4
3%	8.2	3.0	12
5%	9.8	4.1	14
10%	12	6.4	16
20%	16	10	20
50%	27	21	31

#### What does the egg toxicity curve mean?

- The blue line defines the concentration of selenium in an egg that is the best estimate, or most likely, concentration that causes various estimated percentages of reduction in egg hatchability.
- The estimated percent reduction in egg hatchability is commonly referred to as an  $EC_x$ , or effect concentration with an estimated “X” percent reduction in egg hatchability.
- The Upper Confidence Limit and Lower Confidence Limit provide us with an understanding of the uncertainty around the most likely value. We are 95% confident that the given percent reduction in egg hatchability for an egg concentration will occur between these limits. Therefore an  $EC_{10}$ , or 10% effect, could occur for egg selenium concentrations between 6.4 and 16.5 mg Se/kg for mallards. The same range is true for any other  $EC_x$  value.
- The probability, or percent chance, of the Upper Confidence Limit or Lower Confidence Limit occurring is only 2.5% for each end of the range. The  $EC_{10}$  is much more likely to occur near the “maximum likelihood” value.



#### What does an $EC_x$ NOT mean?

- It does NOT mean that X% of the overall bird population using Great Salt Lake will die
- The  $EC_x$  being used considers hatching success and does NOT apply to other endpoints, such as effects on the adult population:
  - ~ Hatching success is a more sensitive endpoint than adult survival